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(54) Method of testing a data frame processing unit or a line termination module in synchronous digital hierarchy (SDH) applications

(57) To test the processing of a data frame processing unit (FPU) which, in a normal working mode, processes input data frames applied to a data frame input (FI) thereof, the data frame processing unit (FPU) is brought in a test mode. Therefore, an active test signal is applied to a test mode control input (TCI) of this data frame processing unit (FPU).

When brought in the test mode, the frame counters of the data frame processing unit (FPU) have lower limits and test data frames with smaller dimensions than the input data frames are applied to the data frame input (FI).

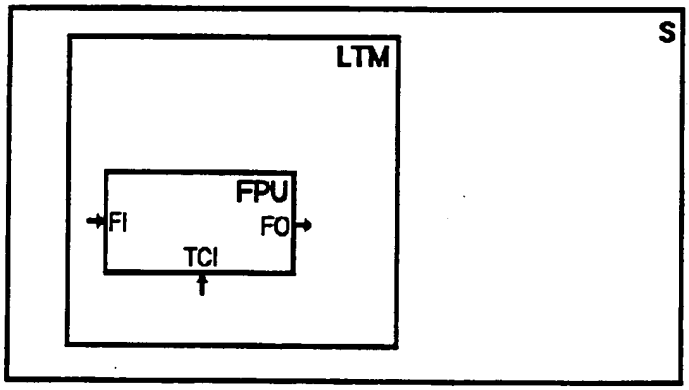

Fig. 2

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Description

The present invention relates to a data frame processing unit, to a line termination module including such a data frame processing unit and to a method for testing such a data frame processing unit, as described in the preambles of claim 1, claim 4 and claim 5 respectively.

Such a data frame processing unit and such a line termination module are already known in the art, e.g. from the article '*A broadband ISDN line termination chip set for 1.2 Gbit/s*', written by *P. Meylemans, L. Cloetens, K. Adriaensen and D. Sallaerts and published in 1993 in the USA by IEEE*. Therein, a set of line termination chips performing external transmission termination functions, external transfer mode termination functions, conversion between external transfer mode and internal transfer mode, and switch fabric termination functions is described. These chips are in fact line termination modules including data frame processing units.

Standardized data frames, processed by such a data frame processing unit however are often very lengthy. STM-1 frames for example, as described in the *CCITT Recommendation G. 709, published in 1991*, have a total length of 2430 bytes. Processing such data frames is very time consuming and consequently test simulations, for testing the functionality of individual samples of the above mentioned line termination chips, require time periods to the extent of several hours. Solutions to speed up the testing of a data frame processing unit or a line termination module are usually searched in the use of faster computers controlling this module or unit, but such computers are very expensive.

An object of the present invention is to provide a data frame processing unit of the above known type but which can be tested in a fast way without using expensive computers.

According to the invention, this object is achieved by means of the data frame processing unit described in claim 1, the line termination module described in claim 4 and the test method for a frame processing unit described in claim 5.

Thanks to the invention, the data frame processing unit can be brought in a test mode wherein test data frames can be processed much faster than the input data frames are processed in the normal working mode, since in test mode only part of the input data frames is handled.

However, a condition to enable the above fast testing of the data frame processing unit by applying test data frames to an input thereof, is that this data frame processing unit processes, in the normal working mode, only a part of the data organised in the input data frames. Indeed, a data frame processing unit which processes, in the normal working mode, e.g. only overhead data whilst the input data frames applied to an input of this data frame processing unit contain user data as well as overhead data, might be tested by applying to this input test data frames which contain only the overhead sections of the input data frames. The length of test data frames containing only a predetermined part of the input data frames is restricted with respect to the length of the input data frames and consequently they are processed faster by the data frame processing unit.

When going from the normal working mode to the test mode, the functionality of the data frame processing unit may not be restricted, otherwise part of the functions performed by the data frame processing unit would not be tested. Nevertheless, the data frame processing unit should be told that test data frames which are smaller than the input data frames will be applied to an input thereof. This is achieved by applying an active test signal to a test mode control input of the data frame processing unit. Therefore the data frame processing unit thus is equipped with such an additional control input and logic enabling to bring this data frame processing unit in the test mode. Once the data frame processing unit is tested and brought back into its normal working mode, the test mode control input and test mode itself are not used.

An additional feature of the present invention is that it is applicable in the field of synchronous digital hierarchy (SDH), as described in claim 2.

Another additional feature of the data frame processing unit according to the present invention is described in claim 3 and solves the problem of adapting the data frame processing unit to be able to process, in the test mode, test data frames with dimensions different from the dimensions of the input data frames.

Indeed, as already mentioned, the data frame processing unit, once it is brought in the test mode, should be told that test data frames with other dimensions will be applied to an input thereof. Therefore the internal frame length of the data frame processing unit should be changed, which in the embodiment as described in claim 3 is done by adapting the frame counter limits of the data frame processing unit.

The above mentioned and other objects and features of the invention will become more apparent and the invention itself will be best understood by referring to the following description of an embodiment taken in conjunction with the accompanying drawings wherein :

Fig 1 is a schematic representation of an embodiment of a data frame processing unit FPU according to the present invention; and

Fig. 2 is a schematic representation of an embodiment of a line termination module LTM according to the present invention.

Referring to Fig. 1, an embodiment of a data frame processing unit FPU according to the present invention will be described.

This embodiment is provided with a data frame input FI, a data frame output FO and a test mode control input TCI, and further includes two frame counters (not shown), generating pointer values to horizontal and ver-

tical positions in frames applied to the data frame input FI.

In a normal working mode, this data frame processing unit FPU processes standardized input data frames, e.g. STM-n frames as described in *CCITT Recommendation G. 709, published in 1991*. Such an STM-n frame contains user data as well as overhead data, both ordered to constitute a frame structure with n x 270 columns and 9 rows. The smallest STM-n frame, which is obviously an STM-1 frame, thus already contains 270 x 9 = 2430 bytes. The columns with index 1 to 9 in such an STM-1 frame carry section overhead data (SOH), whilst the remaining 261 columns constitute a so called virtual container (VC). The fourth row of the section overhead data (SOH) is determined to contain a pointer value referring to the beginning position in the virtual container (VC). Starting from this beginning position, the first column is reserved to carry path overhead data (POH). The last 260 columns of the virtual container (VC) are filled with payload data (PL), which are user data.

The embodiment of the data frame processing unit FPU of Fig. 1 processes, in the normal working mode, only overhead data, i.e. the section overhead data (SOH), the path overhead data (POH), and the first and second column filled with payload data (PL). These data are found in 12 columns of the 270 columns which form part of the STM-1 frames. The payload data (PL) are transferred transparently by the data frame processing unit FPU from the data frame input FI to the data frame output FO.

Before being used, the functionality of each sample of the data frame processing unit FPU should be tested. Due to the length of the predefined STM-1 frames however, testing the functionality requires time periods to the extent of several hours for each individual sample of the data frame processing unit FPU. Nevertheless, most of this test time is wasted to transfer user data transparently from the data frame input FI to the data frame output FO. Therefore, by applying an active test signal to the test mode control input TCI, the data frame processing unit FPU is brought into a test mode wherein the complete functionality of the unit FPU is tested much faster.

Indeed, from the moment on an active test signal is applied to the test mode control input TCI, the frame counter limits of the above mentioned frame counters are reduced. As a result the two frame counters are only enabled to generate pointer values to positions in frames which are smaller than the input data frames. The internal frame length of the data frame processing unit FPU is thus restricted.

Furthermore, if the unit FPU is brought in the test mode, test data frames whose dimensions match with the new frame counter limits are applied to the data frame input FI. To contain only overhead data, the horizontal frame counter limit is reduced from 270 to 12, whilst the vertical frame counter limit remains 9. Consequently, the test data frames include 12 columns and 9 rows and their length equals 9 x 12 = 108 bytes, which implies a reduction of the frame length by a factor 22 when compared to the STM-1 input data frames which, as already mentioned, contain 2430 bytes.

Such test data frames, having smaller dimensions, are generated by adapting for example software programs controlling data frame generating means.

It is noted that for STM-n input data frames, all values in the given example are multiplied by a factor n, values 4, 16 and 64 being currently defined values for the factor n in the above cited CCITT standard. As a result, test simulations for units FPU processing STM-16 or STM-64 frames become executable within an acceptable time period.

Summarizing, the data frame processing unit FPU shown in Fig. 1 speeds up the test procedure with a factor 22 compared to the known data frame processing units, as for example described in the article '*A broadband ISDN line termination chip set for 1.2 Gbit/s*', *from the authors P. Meylemans, L. Cloetens, K. Adriaensen and D. Sallaerts, published in 1993 in the USA and presented there, in San Francisco, on the ISSCC '93 Conference 'Proceedings if the IEEE International Solid State Circuits*'.

In Fig. 2, a line termination module LTM of a telecommunication system S, including a data frame processing unit FPU as described above is shown. Such a line termination module LTM might for example be an interface module between a subscriber and a switch fabric in a synchronous digital hierarchy (SDH) network or any line termination chip described in the above article '*A broadband ISDN line termination chip set for 1.2 Gbit/s*'.

It is to be noted that the technique of using test data frames and bringing the data frame processing unit FPU into a test mode can be used in any synchronous digital hierarchy (SDH) application wherein the data frame processing unit FPU processes, in the normal working mode, only a part of the data organised in the input data frames. In the above description, the STM-1 frames thus may be replaced by any kind of frame used in such applications. Obviously, the data frame processing unit FPU, in the normal working mode, might process overhead data only as in the above described embodiment, user data only, or a combination of both.

While the principles of the invention have been described above in connection with specific apparatus, it is to be clearly understood that this description is made only by way of example and not as a limitation on the scope of the invention.

Claims

1. A data frame processing unit (FPU) adapted to process, in a normal working mode, input data frames applied thereto via a data frame input (FI) thereof, characterized in that said data frame processing unit (FPU), is adapted to process, in a test mode, test data frames containing a predeter-

mined part of said input data frames and needed for testing purposes, said test data frames being applied to said data frame processing unit (FPU) via said data frame input (FI) and said data frame processing unit (FPU) being brought in said test mode by applying an active test signal to a test mode control input (TCI) thereof.

2. A data frame processing unit (FPU) according to claim 1, characterized in that said input data frames are dedicated to synchronous digital hierarchy (SDH) applications.

3. A data frame processing unit (FPU) according to claim 1, characterized in that said data frame processing unit (FPU) includes frame counters generating pointer values pointing to data elements in a said frame, frame counter limits of said frame counters being adaptable according to the status of said test signal.

4. A line termination module (LTM) of a telecommunication system (S), said line termination module (LTM) including at least one data frame processing unit (FPU) adapted to process, in a normal working mode, input data frames applied thereto via a data frame input (FI) thereof, characterized in that said data frame processing unit (FPU) is adapted to process, in a test mode, test data frames containing a predetermined part of said input data frames and needed for testing purposes, said test data frames being applied to said data frame processing unit (FPU) via said data frame input (FI) and said data frame processing unit (FPU) being brought in said test mode by applying an active test signal to a test mode control input (TCI) thereof.

5. A method for testing a data frame processing unit (FPU) which processes, in its normal working mode, input data frames applied to a data frame input (FI) thereof, characterized in that for testing purposes said data frame processing unit (FPU) is first brought in a test mode by applying an active test signal to a test mode control input (TCI) thereof, then test data frames containing a predetermined part of said input data frames are applied to said data frame input (FI), and finally said test data frames are processed by said data frame processing unit (FPU).

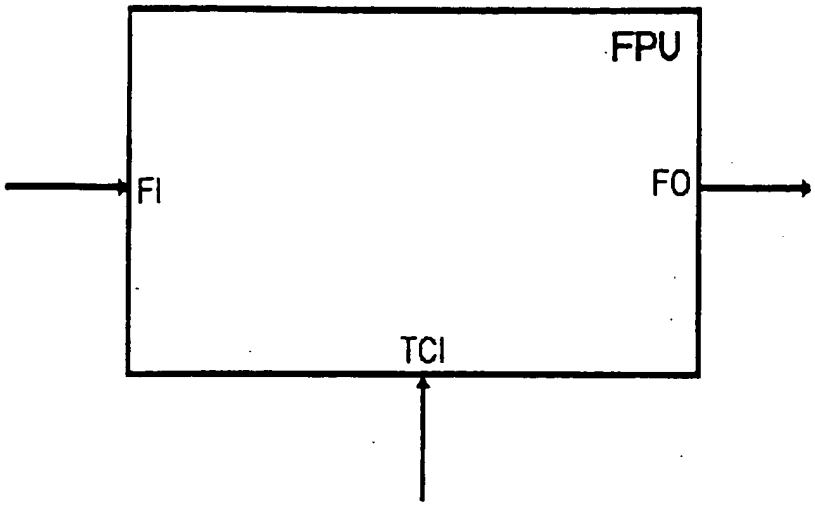

Fig. 1

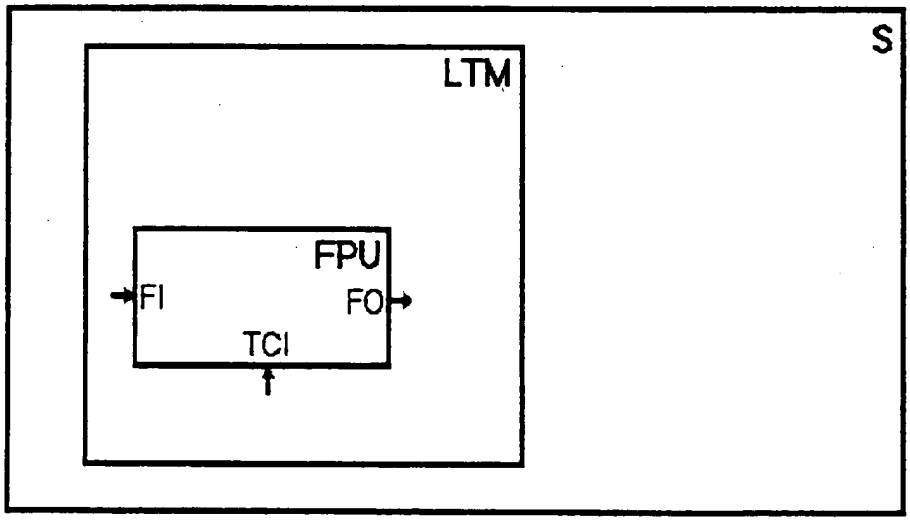

Fig. 2

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EUROPEAN SEARCH REPORT

Application Number
EP 95 20 0398

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A	WO-A-94 13073 (NOKIA TELECOMMUNICATIONS OY) * page 1, line 26 - page 4, line 17 * * page 5, line 7 - page 6, line 31; figures *	1-5	H04L1/24 H04L12/26 H04J3/14
A	US-A-5 289 474 (PURCELL ET AL.) * abstract * * column 1, line 46 - line 55 * * column 1, line 59 - column 2, line 46 * * column 5, line 54 - line 68 * * column 9, line 5 - line 8 * * column 9, line 64 - line 67 *	1-5	
A	PROCEEDINGS OF THE NATIONAL COMMUNICATIONS FORUM, 30.09.-02.10.1991, vol.45, 30 September 1991, CHICAGO US pages 420 - 423, XP267438 G. RHIND: 'The Test Challenge of SONET.' * the whole document *	1-5	
			TECHNICAL FIELDS SEARCHED (Int.Cl.6) H04L H04J

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	21 July 1995	Gries, T

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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